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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/822,414	04/02/2001	Hiroya Kirimura	P107351-00011	9442

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ARENT FOX KINTNER PLOTKIN & KAHN, PLLC
SUITE 600
1050 CONNECTICUT AVENUE, N.W.
WASHINGTON, DC 20036-5339

EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1722	

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06/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/822,414	KIRIMURA ET AL.	
	Examiner	Art Unit	
	Matthew J. Song	1722	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 March 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *26-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *26-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3/21/2007 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 31, 33-34 and 37-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344).

In a method of forming a single crystalline thin film by beam irradiation, note entire reference, Asakawa et al teaches forming an amorphous silicon film on a substrate using plasma chemical vapor deposition, this clearly suggests applicant's prefilm, while simultaneously irradiating the substrate with beams of low energy gas, this clearly suggests applicant's energy beam (col 4, ln 30-67). Asakawa et al also teaches the amorphous thin film is converted to form a single crystalline film (col 4, ln 30-50). Asakawa et al teaches the substrate can be scanned by a substrate moving means, whereby it is possible to from a single crystalline thin film having high homogeneity on a long substrate (col 10, ln 5-45; Eleventh Preferred Embodiment). Asakawa et al also teaches it is possible to facilitate formation of an amorphous thin film by intermittently applying beams from an ion source while regularly supplying a reaction gas and rotating the substrate during application pauses (col 12, ln 1-50). Asakawa et al also teaches neon ions can be accelerated to 200-600 eV by an ion source **83** (col 23, ln 20-55). Asakawa et al also teaches a plasma CVD process (col 32, ln 1-67). Asakawa et al also teaches a reaction chamber coupled to a vacuum unit (col 27, ln 1-15), this clearly suggests applicant's vacuum chamber. Asakawa et al teaches formation of an amorphous film by intermittently applying beams from an ion source while supplying reaction gas. Asakawa et al teaches a pre-film of the crystalline silicon film is formed on the target surface while emitting an ion beam to the substrate in the step of form the pre-film by the film forming device (col 4, ln 50-67). Asakawa et al also teaches it is possible to efficiently irradiate a wide region on the substrate in a single scanning by scanning the substrate in a direction which is perpendicular to the "strip of the atom current" and the substrate is

scanned by a substrate moving means (col 10, ln 5-20 and col 59, ln 5-65), this clearly suggests applicant's emitting the ion beam in the first direction and moving the substrate in a linear second direction crossing the first direction because the substrate is moved perpendicular to the beam strip.

Asakawa et al does not teach using an energy beam consisting of a laser beam or an electron beam to produce an intended crystalline silicon film.

In a method of forming a semiconductor device by crystallizing silicon, note entire reference, Zhang et al teaches a method of forming a crystalline silicon film comprising a plasma chemical vapor deposition (CVD) apparatus, this reads on applicants' film forming device, provided with a window of quartz so that a laser can be irradiated from the outside, this reads on applicants' laser beam irradiating device (col 5, ln 60 to col 6, ln 20). Zhang et al also teaches a non-crystalline silicon hydride semiconductor layer **13** was formed by plasma CVD and crystallization of the sample was effected by an excimer laser irradiation (col 5, ln 5-61 and claim 1). Zhang et al also teaches the processes from the film forming to the laser irradiation may be effected in succession without a transfer of the sample instead of using a chamber exclusively used in the laser annealing (col 5, ln 60 to col 6, ln 10), this clearly suggests applicants' producing the intended crystalline silicon film from the pre-film by irradiating the pre-film in the vacuum chamber subsequently to the formation of the pre-film.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Asakawa et al by crystallizing with laser light as taught by Zhang et al to improve the crystallinity of the silicon film.

Referring to claim 33, Asakawa et al discloses supplying a reaction gas onto a substrate allowing no crystallization of the material with plasma CVD while simultaneously irradiating the substrate with beams of low energy gas to covert the amorphous film to a crystal having a regulated crystal orientation (col 4, ln 30-67). Asakawa et al does not discloses a dehydrogenation process, this clearly suggests applicant's limitation of without conducting a dehydrogenation process. Furthermore, the crystallization of the amorphous film with the energy beam occurs simultaneously with the formation of the amorphous film; therefore a dehydrogenation process cannot occur and a dehydrogenation process, as described by applicant's, which requires a separate heat treatment, which is not taught by Asakawa et al.

Referring to claim 34, Asakawa et al teaches the substrate can be scanned by a substrate moving means, whereby it is possible to from a single crystalline thin film having high homogeneity on a long substrate (col 10, ln 5-45; Eleventh Preferred Embodiment), this clearly suggests applicant's concurrently operating the energy beam device to irradiate

Referring to claim 31, Asakawa et al teaches plasma CVD (col 33, ln 20-45).

Referring to claims 37-38, Asakawa et al teaches formation of an amorphous film by intermittently applying beams from an ion source while supplying reaction gas, this clearly suggests applicant's ion beam is emitted to the target surface of the substrate in an initial stage of the forming of the pre-film.

4. Claim 26-30, 35-36 and 41-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344) as applied to claim 31, 33-34 and 37-40 above, and further in view of Selvakumar et al (US 5,633,194).

The combination of Asakawa et al and Zhang et al teaches all of the limitations of claim 35, as discussed previously in claim 33, an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film

In a method of forming epitaxial grown Si utilizing ion beams (col 1, ln 35-65), Selvakumar et al teaches in-situ cleaning of a substrate surface by argon ion bombardment prior to the start of deposition, where a 200 eV argon ion beam was used to sputter clean the substrate in a necessary step which significantly influences the quality of a grown film by removing native oxide. Selvakumar et al also discloses an inexpensive ion beam vapor deposition technique used to grow silicon films, where an ion source **13** was used to ionize a gas to accelerate an ion beam towards a substrate with a current between 30-1000 eV using high purity argon and silane gases as sources for the ion beam (col 6, ln 20-65; col 7, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al and Zhang et al with Selvakumar et al to clean the substrate.

Referring to claim 26-29, the combination of Asakawa et al, Zhang et al and Selvakumar et al teaches an ion beam where a current can be adjusted between 30-1000 eV and a cleaning at 200 eV. Overlapping ranges are held to be obvious (MPEP 2144.05). Furthermore, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al, Zhang et al and Selvakumar et al by optimizing the emission energy by conducting routine experimentation.

Referring to claim 30, Overlapping ranges are held to be obvious (MPEP 2144.05).

5. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344) as applied to claim 31, 33-34 and 37-40 above, and further in view of Ahn et al (US 5,470,619).

The combination of Asakawa et al and Zhang et al teaches all of the limitations of claim 32, as discussed previously, except plasma CVD using hydrogen gas.

In a method of forming amorphous silicon films using plasma CVD, note entire reference, Ahn et al teaches a substrate placed in a PECVD chamber heated from room temperature to 600°C in an atmosphere of a source gas to deposit an amorphous silicon film, thereon. Ahn et al also teaches using Si_2H_6 or H_2 diluted SiH_4 as a source, which is less expensive.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al and Zhang et al by using a H_2 diluted SiH_4 source gas because it is conventionally known in the art to be used in plasma CVD processes to from amorphous silicon and it is less expensive, thereby reducing cost.

Response to Arguments

6. Applicant's arguments with respect to claims 26-45 have been considered but are moot in view of the new ground(s) of rejection.

7. Applicant's arguments filed 3/21/2007 have been fully considered but they are not persuasive.

Applicant's argument that the new limitation is not taught by the prior art is noted but is not found persuasive. Asakawa et al also teaches it is possible to efficiently irradiate a wide region on the substrate in a single scanning by scanning the substrate in a direction which is perpendicular to the "strip of the atom current" and the substrate is scanned by a substrate moving means (col 10, ln 5-20 and col 59, ln 5-65), this clearly suggests applicant's emitting the ion beam in the first direction and moving the substrate in a linear second direction crossing the first direction because the substrate is moved perpendicular to the beam strip.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Masumo et al (US 5,306,651) teaches a semiconductor is subjected to laser irradiation to improve the crystallinity (col 3, ln 25-35).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra Gupta can be reached on 571-272-1316. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1722

MJS
June 5, 2007

ROBERT KUNEMUND
PRIMARY PATENT EXAMINER
A.U. 1722